International Journal of Electronics,
Communication & Instrumentation Engineering
Research and Development (IJECIERD)
ISSN(P): 2249-684X; ISSN(E): 2249-7951
Vol. 4, Issue 3, Jun 2014, 119-126

ANALYSIS OF CONTRAST STRETCHING USING NEURAL HAMMINGTON DISTANCE METHOD

MANISH SINGH, MUKESH KUMAR, A.K. JAISWAL & ROHINI SAXENA

Department of Electronics and Communication Technology, Shephard School of Engineering and Technology,
Sam Higginbottom Institute of Agriculture, Technology and Sciences (Deemed-to-be University), Allahabad, India

ABSTRACT

Image Enhancement is the process to sharpen the features of an image, so that result is more suitable than original image for specific applications. The enhancement method increases the predetermined range of the selected feature so that it can be detected easily instead of only increment in the inherent range of that particular feature. The report will provide an overview of techniques commonly used for image enhancement. The report focuses on the contrast stretching technique by using Neural Hammington Distance Method. The proposed method is an algorithm which reads image pixels and after some manipulations image will get stretched with better result. The images which are dull and have low grey levels are being stretched and made clearer by using this technique for they will become easier for further processing.

KEYWORDS: Hamming Distance, Contrast Stretching, Neural Hammington Distance, ANN, Image Enhancement

INTRODUCTION

The essential goal of image enhancement is to process the input image in such a way that the output image is more suitable for interpretation by the humans as well as by machines. Here a method is proposed which can enhance an image by stretching its contrast properties, known as neural hamming distance method, which can influence the image and provide the result with better contrast, so that the image can be read easily. The Hamming Distance between two strings of equal length is the number of positions at which the corresponding symbols are different. In another way, it measures the minimum number of substitutions required to change one string into the other, or the minimum number of errors that could have transformed one string into the others. The Hamming distance between two words is the number of edges in a shortest path connecting the corresponding vertices. Based on the hamming distance method this neural technology finds the dull and dim pixel of the image and by manipulating the pixel value the contrast of the image will get stretched. Contrast is the scale of difference between black and white in an image. Without contrast the image wouldn't have any differentiation between light and dark; everything would be black, white, or a single shade of grey somewhere in between. Contrast is the difference in visual properties that represents an image in a noticeably different manner. It is the Difference in the brightness level of an image which differentiates between the lighter and brighter pixels of the image and so it can be classified as high contrast or low contrast image. Contrast enhancement is fundamental steps in Display of digital images. And design effective contrast enhancement requires understanding of human brightness perception.

Methodology

The contrast stretching method is a type of point processing method in spatial domain technology of image enhancement. Many methods have been come across for enhance an image to stretch its contrast property, although many

have done it, but there are some drawbacks regarding the results of enhancement. The technology that is based on Neural Network will overcome these detracts named as Neural Hammington Distance Method.

Contrast Stretching

Contrast is the scale of difference between black and white in images. It is the basic property of an image which differentiates between the light and dark portion of it. With the knowledge of contrast the image can easily be noticeable and can easily be readable. Contrast enhancement is fundamental steps in Display of digital images. And design effective contrast enhancement requires understanding of human brightness perception. Contrast stretching generally known as normalization is a simple image enhancement technique that is used to improve the contrast in an image by stretching the range of intensity values it contains to measure a desired range of values, e.g. the full range of pixel value that the related image type concerned allows. It differentiates between the more delicate histogram equalization in that it can only apply a linear scaling function to the image pixel values. As a result the enhancement is less rough.

Before the stretching can be performed it is necessary to specify the upper and lower pixel value limit due to that the image can be normalized. The limits will be the minimum and maximum pixel value that the image type concerned allows. For example for 8-bit gray level images the lower and upper limits might be 0 and 255. Call the lower and the upper limits 'a' and 'b' respectively.

The simplest sort of normalization then scans the image to find the lowest and highest pixel values currently present in the image. Call these 'c' and 'd'. Then each pixel 'P' is scaled using the following function

$$P_{out} = (P_{in} - c)\left(\frac{b-a}{d-c}\right) + a \quad (1)$$

Values below 0 are set to 0 and values about 255 are set to 255.

The problem with this is that a single distant pixel with either a very high or very low value can badly affect the value of 'c' or 'd' and this could lead to very unrepresentative scaling. Therefore after generating histogram the values of 'c' and 'd' is to be selected as the 5^{th} and 95^{th} percentile of the histogram of the image. This method prevents the scaling to be affecting from the outliers.

ARTIFICIAL NEURAL NETWORK

Image Processing is an area of investigation that uses several techniques and algorithms in order to interpret and understand the information contained in a digital image one of them is Artificial Neural Network. ANN being inspired on the nervous system, its usefulness for solving pattern recognition problems and their parallel architectures are better than other techniques. Artificial Neural Network (ANN) is being used from many past years for the growth of new and effective algorithms in Image Processing which can be useful in the fields of engineering, medicine and science. ANN is based on function of biological neural network and hence can be addressed as a program of biological neural system. ANN is a kind of artificial intelligence which produces results with least errors. ANN gives rise to the intelligence as an existent property of complex, adaptive system by aiming at generation of implicit processing mechanisms. Neural network systems have been developed for fields such as pattern recognition, capacity planning, business intelligence, robotics, or even for some form of intuitive problem solving. In computer science, neural networks gained a lot of steam over the last few years in areas such forecasting, data analytics, as well as data mining. It requires less manual work and more rely on automatic

procedures. It is more reliable and may provide better results. It can perform intelligent tasks similar to those performed by the human brain.

NEURAL HAMMINGTON DISTANCE METHOD

A simple enhancement techniques can be used to rectify it if required, as an image needs some manipulations but since these simple techniques are not enough as some defects will still remain in the image, to overcome this it need to be modify more and for that a new technique based on artificial neural network has come into focus. One of them is neural hammington distance method, which works on each and every pixel of an image and provides a better result.

Neural Hammington Distance Method is based on hamming distance calculation method. The Hamming distance between two strings of equal length is the number of positions at which the corresponding symbols are different. In another way, it measures the minimum number of substitutions needed to change one string into the other, or the minimum number of errors that could have transformed one string into the other. Hamming distance is basically used find out the error and then corrects it. It is simply defined as the number of bits that are different between two bit vectors. The hamming distance between the two states being sought and the set of error states is used as an assessment function to guide the search. The states that have a lower hamming distance to the largest enlarged target are processed first. The states with very few bits differing from the enlarged target will require very few cycles to reach that target. When the states have reached an enlarged target the hamming distance will become zero. The Hamming distance between two words 'a' and 'b' can also be seen as the Hamming weight of 'a−b' for an appropriate choice of the '−'operator. Hamming weight analysis of bits is used in several disciplines including information theory, coding theory, and cryptography. The Hamming Distance is a number used to denote the difference between two binary strings. It is a small portion of a broader set of formulas used in information analysis. Specifically, hamming's formula allow computers to detect and correct error on their own. Following are the steps to calculate hamming distance of two strings:-

- Ensure the two strings are of equal length. The Hamming distance can only be calculated between two strings of equal length. String 1: "111100001010" String 2: "101011110001".
- Compare the first bit in each string. If they are the same, record a "0" for that bit. If they are different, record a "1" for that bit. In this case, the first bit of both strings is "1," so record a "0" for the first bit.
- Compare each bit in succession and record either "1" or "0" as appropriate. String 1: "111100001010" String 2: "101011110001" Record: "010111111111".
- Add all the ones and zeros in the record together to obtain the Hamming distance. Hamming distance = 0+1+0+1+1+1+1+1+1+1+1+1 = 10.

The proposed neural hammington method uses this hamming distance measurement technique and finds the shortest distance between the layers of neuron from output layer to the input layer and by doing so every pixel of the image is being worked on and the contrast of the image changes.

Working of Proposed Method

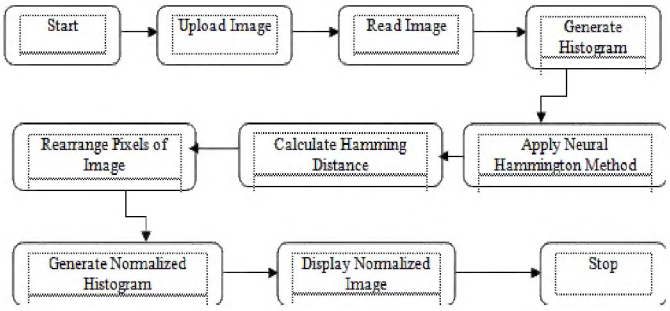

Figure 1: Block Diagram of Neural Hammington Distance Method for Contrast Stretching

Working block diagram of the Neural Hammington Method is presented here. The image in which changes have to be done is being uploaded into the Matlab, after reading the image by giving all values of pixels of the image, it generates histogram of the image. Histogram of an image is the graph between the pixel value and the occurrence of it in the image. The histogram is very useful in reading an image, by virtue of which one can easily come to know about the properties of an image, with the help of which one can perform its required manipulation for an image. After generation of histogram of our image, this tells that the image being used is not much bright enough. The image needs to be enhanced as its contrast property is low and for normalizing the contrast, Neural Hammington Method is applied. After the application of proposed method, it starts calculating the pixel to pixel distance, since each distance from input layer to the output layer is different, with the help of the algorithm shortest distance between each pixel of output layer to the input layer being measured. This distance helps in manipulating the pixel value and its distance from every other pixel. By doing so properties of an image gets changed. The Neural Hammington method automatically finds the pixel which needs to be rearranged and after rearranging it the image gets its new properties. The image gets normalized by some manipulations in its pixel values and in their occurrence.

EXPERIMENTAL RESULTS

Experiments are taken out to verify the electiveness of the discussed method by applying it to a digital image named as Joanna.jpg. The image experimented shown in figure 2.

Figure 2: Original Image "Joanna.jpg"

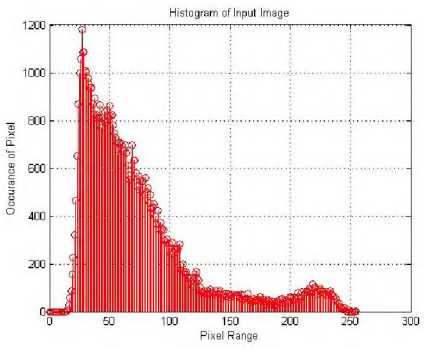

Figure 3: Histogram of Original Image

It is clearly visible that the image is very dark and dull. The face and some background part of the image are very dark. Histogram of the original Joanna image is shown in the figure 3.

Figure 4: Enhanced Image

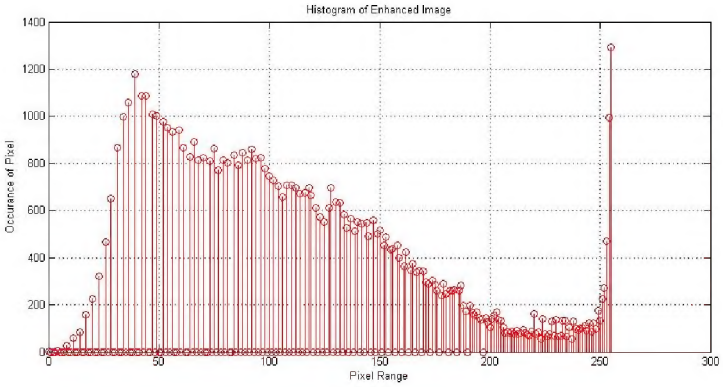

Figure 5: Histogram of Enhanced Image

From the experiment result, it is quite clear that in the original image, the face and dress texture detail is not very obvious and the image is a bit of dark, the contrast in the image is also lower. While, when the image has been enhanced by the method proposed, the above problems have been solved and a satisfactory image has been produced, in which brightness and contrast are well balanced, visual effects of the experiment image has been improved very well. Meanwhile, from the histogram figure 3 and figure 5, it is obvious that the image gray distribution is more even and the dark gray region allocation in the image is more reasonable. The proposed methodology of Neural Hammnigton Method is appreciable and efficient in balancing the contrast and brightness of the image. The method has a vivid future and would be a matter of interest for the researchers and new technologies being developed by the employment of these methodologies. And it can be useful in customer electronics to allow scaling of brightness and contrast preservation suited to individual image.

There are two error metrics which is used to compare the quality of image enhancement, that are known as MSE and PSNR. The MSE represents the cumulative squared error between the enhanced and the original image, whereas PSNR represents a measure of the peak error. Lower the value of MSE lowers the error.

$$PSNR_{db} = 10log_{10}\frac{(2n-1)2}{MSE} \quad (2)$$

PSNR tells us about the quality of image, more the PSNR value better will be the result.

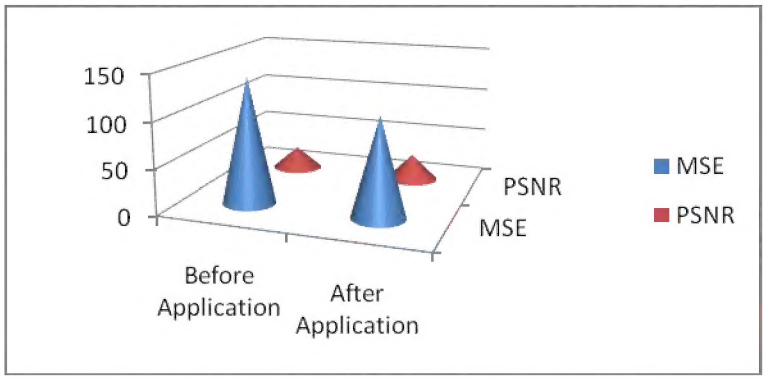

Figure 6: Comparison of MSE and PSNR for Proposed Algorithm

Figure 6 shows the comparison between the MSE and PSNR values of general contrast stretching method and proposed methodology. The parameters say that the proposed methodology is better than the contrast stretching method.

CONCLUSIONS

- The successful study of all the methods involve to enhance an image has been done and concluded that all the techniques are easy to learn and are capable of enhancing an image in a proper and as per the required result. Also the contrast stretching techniques has many methods as linear and non-linear contrast stretching methods which are used to enhance an image by giving satisfactory results.
- The proposed methodology of Neural Hammington Distance Method is appreciable and efficient in balancing the contrast and brightness of the image in comparison to the general stretching methods, as the MSE and PSNR values are better after the application of the proposed method.

ACKNOWLEDGEMENTS

I have taken efforts for this synopsis report. However, it would not have been possible without the kind support and help of many individuals. I would like to extend my sincere thanks to all of them. I am highly indebted to Er. Mukesh Kumar, Asstt. Professor, ECE Department, for their guidance and supervision. They provided necessary information regarding the report & presentation.

I would like to express my gratitude towards Er. Anil Kumar and Er. Rajeev Paulus, Asstt. Professor, ECE department for their kind co-operation and encouragement which help me in completion of this report. My thanks and appreciations also go to my colleague in developing the report and people who have willingly helped me out with their abilities.

REFERENCES

1. Deng W, Zheng Q, Chen L, Xu X (2010), *Research on Extreme Learning of Neural Networks,* Chinese Journal of Computers, vol.33, pp. 279-287.
2. Gao C, Zhou J (2011), *Image Enhancement Based on Quaternion Fractional Directional Differentiation*, ACTA AUTOMATICA SINICA, vol.37, pp. 150-159.
3. Li S, Liu L, Xie Y (2011), *Chaotic prediction for short-term traffic flow of optimized BP neural network based on genetic algorithm*, Control and Decision, vol.26, pp. 1581-1585.
4. Liang L, He W, Lei L, Zhang W, Wang H (2010), *Survey on enhancement methods for non-uniform illumisnation image,* Application Research of Computers, vol.27, pp. 60-63.
5. Liu Z, Yang W, Zhu Q (2010), *A Comparative Study on Several Algorithms of Image Enhancement,* Journal of Hefei Normal University, vol.28, pp. 60-63.
6. Luo X, Tian J (2002), *Image Enhancement and Minutia Matching Algorithms in Automated Fingerprint Identification System*, Journal of Software, vol.13, pp. 946-956.
7. Mao W, Zhao X (2010), *Enhancement algorithm for low2illumination color image based on neural network*, OPTICAL TECHNIQUE, vol.36, pp. 225-228.
8. Wang R, Zhang X, Shuai S (2011), *Image Enhancement in the Compressed Domain Based on Retinex Theory*, Journal of Computer Research and Development, vol.48, pp. 259-270.

9. Yang Z, Zhou J, Yan X, Huang M (2008), *Image Enhancement Based on Fractional Differentials,* Journal of Computer-Aided Design & Computer Graphics, vol.20, pp. 343-348.

10. Zhang N (2007), *Research on Image Enhancement Technology,* Computer Simulation, vol.24, pp. 192-195.

AUTHOR'S DETAILS

Manish Singh is persuing M.Tech from SHIATS(deemed to be university) Allahabad in Department of Electronics and Communication Engineering. He received his B.Tech degree in Electronics and Communication from RTU, Kota, Rajasthan in 2012. His area of interest is in signal processing and image processing.

Mukesh Kumar is working as an Asst. Prof. in the Department of Electronics & Communication Engineering in SHIATS, Allahabad. He received his M.Tech. Degree in Advanced Communication System Engineering from SHIATS, Allahabad in 2010. His research is focused on Signal processing and Microwave Engineering.

A.K. Jaiswal is Prof. and Head of ECE Dept. at SHIATS-Allahabad. He Obtained M.Sc. in Tech. Electronic & Radio Engg. from Allahabad University in 1967.He guided various projects & research at undergraduate & postgraduate level. He has more than 35years Industrial, research & Teaching experience and actively involved in research and publications. His area of interest includes Optical Networks and satellite communication.

Rohini Saxena is working as a Asst. Prof. in the Department of Electronics & Communication Engineering in SHIATS, Allahabad. She received her M.Tech. Degree in Advanced Communication System Engineering from SHIATS, Allahabad in 2009. Her research is focused on, Microwave Engineering, Signal Processing, Computer Networks and Mobile Communication.